

HC Verma Solutions Rotational Mechanics

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Rotational Mechanics HC Verma Concepts of Physics Solutions

Rotational Mechanics HC Verma Concepts of Physics Solutions Chapter 10

1. $\omega_0 = 0 ; \rho = 100 \text{ rev/s} ; \omega = 2\pi ; \rho = 200 \pi \text{ rad/s}$

$$\Rightarrow \omega = \omega_0 = \alpha t$$

$$\Rightarrow \omega = \alpha t$$

$$\Rightarrow \alpha = (200 \pi)/4 = 50 \pi \text{ rad/s}^2 \text{ or } 25 \text{ rev/s}^2$$

$$\therefore \theta = \omega_0 t + 1/2 \alpha t^2 = 8 \times 50 \pi = 400 \pi \text{ rad}$$

$$\therefore \alpha = 50 \pi \text{ rad/s}^2 \text{ or } 25 \text{ rev/s}^2$$

$$\theta = 400 \pi \text{ rad.}$$

2. $\theta = 100 \pi ; t = 5 \text{ sec}$

$$\theta = 1/2 \alpha t^2 \Rightarrow 100\pi = 1/2 \alpha 25$$

$$\Rightarrow \alpha = 8\pi \times 5 = 40 \pi \text{ rad/s} = 20 \text{ rev/s}$$

$$\therefore \alpha = 8\pi \text{ rad/s}^2 = 4 \text{ rev/s}^2$$

$$\omega = 40\pi \text{ rad/s}^2 = 20 \text{ rev/s}^2.$$

3. Area under the curve will decide the total angle rotated

$$\therefore \text{maximum angular velocity} = 4 \times 10 = 40 \text{ rad/s}$$

$$\text{Therefore, area under the curve} = 1/2 \times 10 \times 40 + 40 \times 10 + 1/2 \times 40 \times 10 \\ = 800 \text{ rad}$$

$$\therefore \text{Total angle rotated} = 800 \text{ rad.}$$

4. $\alpha = 1 \text{ rad/s}^2, \omega_0 = 5 \text{ rad/s}; \omega = 15 \text{ rad/s}$

$$\therefore \omega = \omega_0 + \alpha t$$

$$\Rightarrow t = (\omega - \omega_0)/\alpha = (15 - 5)/1 = 10 \text{ sec}$$

$$\text{Also, } \theta = \omega_0 t + 1/2 \alpha t^2$$

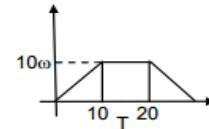
$$= 5 \times 10 + 1/2 \times 1 \times 100 = 100 \text{ rad.}$$

5. $\theta = 5 \text{ rev}, \alpha = 2 \text{ rev/s}^2, \omega_0 = 0 ; \omega = ?$

$$\omega^2 = (2 \alpha \theta)$$

$$\Rightarrow \omega = \sqrt{2 \times 2 \times 5} = 2\sqrt{5} \text{ rev/s.}$$

$$\text{or } \theta = 10\pi \text{ rad, } \alpha = 4\pi \text{ rad/s}^2, \omega_0 = 0, \omega = ?$$



$$\omega^2 = (2 \alpha \theta)$$

$$\Rightarrow \omega = \sqrt{2 \times 2 \times 5} = 2\sqrt{5} \text{ rev/s.}$$

$$\text{or } \theta = 10\pi \text{ rad, } \alpha = 4\pi \text{ rad/s}^2, \omega_0 = 0, \omega = ?$$

$$\omega = \sqrt{2\alpha\theta} = 2 \times 4\pi \times 10\pi$$

$$= 4\pi\sqrt{5} \text{ rad/s} = 2\sqrt{5} \text{ rev/s.}$$

6. A disc of radius = 10 cm = 0.1 m

$$\text{Angular velocity} = 20 \text{ rad/s}$$

$$\therefore \text{Linear velocity on the rim} = \omega r = 20 \times 0.1 = 2 \text{ m/s}$$

$$\therefore \text{Linear velocity at the middle of radius} = \omega r/2 = 20 \times (0.1)/2 = 1 \text{ m/s.}$$

7. $t = 1 \text{ sec, } r = 1 \text{ cm} = 0.01 \text{ m}$

$$\alpha = 4 \text{ rad/s}^2$$

$$\text{Therefore } \omega = \alpha t = 4 \text{ rad/s}$$

Therefore radial acceleration,

$$A_n = \omega^2 r = 0.16 \text{ m/s}^2 = 16 \text{ cm/s}^2$$

$$\text{Therefore tangential acceleration, } a_t = \alpha r = 0.04 \text{ m/s}^2 = 4 \text{ cm/s}^2.$$

8. The Block is moving the rim of the pulley

$$\text{The pulley is moving at a } \omega = 10 \text{ rad/s}$$

$$\text{Therefore the radius of the pulley} = 20 \text{ cm}$$

$$\text{Therefore linear velocity on the rim} = \text{tangential velocity} = r\omega$$

$$= 20 \times 20 = 200 \text{ cm/s} = 2 \text{ m/s.}$$



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